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# **COSUMNES POWER PLANT (01-AFC-19)**

## **DATA RESPONSE, SET 1E**

(Supplemental Responses to Data Requests:  
111, 112, 116, 152, and 161)

## **POWER PLANT COOLING ANALYSIS**

Submitted by  
**Sacramento Municipal  
Utility District (SMUD)**

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## EXECUTIVE SUMMARY

The Sacramento Municipal Utility District (SMUD or District) performed this Power Plant Cooling Analysis to identify the best method of cooling the Cosumnes Power Plant (CPP), taking into account environmental impacts, technical constraints, energy efficiency, economic impact to SMUD customer-owners, power plant reliability, legal requirements and other factors specific to each alternative. This analysis also elaborates upon and quantifies the District's initial responses to California Energy Commission (CEC) staff Data Requests 111, 112, 115, 152 and 161 (a copy of Data Responses 111 and 112 is provided in Appendix A). This review of cooling alternatives is sufficiently complex that it exceeds the limits of these requests. This analysis also provides a description of SMUD's water use in relation to the Central Valley's water supply, and how these principles can be used to draw conclusions for cooling at CPP. A complete review of various alternatives to the proposed recirculating wet-cooling system for CPP is also presented.

It may be surprising that apparent "best uses" of water in the form of alternative cooling technologies actually result in degradation of the environment in many ways. SMUD's findings in this report are consistent with a December 18, 2001 U.S. Environmental Protection Agency (USEPA) ruling, which determined that ***recirculating wet cooling, as proposed for CPP, is USEPA's recommended cooling option*** when taking into account all environmental factors, including the goal of preserving and conserving all of the nation's resources. The USEPA reports there is a significant energy penalty from dry cooling, resulting in increased fuel consumption and air emissions. By using recirculating wet cooling, CPP is an extremely efficient combined-cycle plant that makes best use of the nation's resources.

Although alternative technologies such as dry cooling and hybrid wet/dry cooling may be feasible in arid regions where availability of water is in scarce supply, or where the climate is milder than that of the Central Valley in California, the use of dry cooling simply is inappropriate for the set of conditions at CPP, particularly given SMUD's unique situation in terms of protected water rights, its prior investment in the Folsom-South Canal (FSC) conveyance facility, and its participation in the Sacramento Regional Water Forum. ***SMUD takes its responsibilities to the American River and its commitment to the Sacramento Water Forum and its 40 Water Forum Stakeholders very seriously.*** The 40 Water Forum Stakeholders recognize these commitments and water allocations through their signature in upholding the Water Forum Agreement.

The use of alternative technologies is not entirely benign to the environment. Natural gas is a non-renewable resource that must be conserved. Once fuel undergoes the chemical reaction of combustion, it can never be reused. ***Dry cooling wastes fuel and would reduce the output of a 1,000 MW power plant by more than 41 MW during***

**the hottest periods when customer demand is the greatest.** This is the equivalent of operating a less efficient peaker plant just to overcome dry cooling's inefficiency.

Conversely, unevaporated water, once used and recycled in power plant operations, can be treated for beneficial downstream uses, and evaporated water ultimately returns to the earth after running through the hydrologic cycle. In the case of CPP, water discharged under a National Pollutant Discharge Elimination System (NPDES) permit helps preserve riparian habitat in Clay Creek, Hadselville Creek, Laguna Creek and the Cosumnes River as it makes its way to the Delta. This water also provides fishery habitat, provides water for agricultural irrigation, and helps recharge the diminishing groundwater table in south Sacramento County through permeation into the sandy and rocky soil of natural streambeds. Alternatives to recirculating wet cooling and discharge to Clay Creek would eliminate this potential benefit. Alternative water sources to FSC, such as groundwater, reclaimed water and brackish water, would also eliminate this potential benefit because such water sources could not meet NPDES requirements for discharge to Clay Creek. Instead, these water sources would require the use of a zero-liquid discharge (ZLD) system that would include an added energy penalty. In addition, use of groundwater would contribute to a current overdraft condition.

In addition, alternatives to recirculating wet cooling have other substantial impacts. These include impacts to air quality, land use, noise, visual aesthetics, and loss of natural habitat. **Loss of power plant efficiency through alternative cooling means more fuel is needed to generate an equivalent amount of power.** During peak demand, power would need to be imported or generated to make up this loss. This simply means that another power plant would need to be built or operated somewhere, resulting in more air pollution per megawatts generated.

The cost benefit of recirculating wet cooling using FSC water is summarized by comparison to alternative cooling methods and water sources. The net present value costs listed below include equipment installation, water conveyance, operation and maintenance costs, and associated energy penalty over 30 years.

• <i>Proposed recirculating wet cooling using FSC water</i>	<i>\$36.3 million</i>
• <i>Dry cooling (air-cooled condenser)</i>	<i>\$370.2 million</i>
• <i>Hybrid (wet/dry) cooling using FSC water</i>	<i>\$279.3 million</i>
• <i>Recirculating wet cooling using reclaimed water</i>	<i>\$89.5 million</i>
• <i>Recirculating wet cooling using brackish water</i>	<i>\$100.2 million</i>

The major difference between CPP and most other projects before the Commission is that SMUD is a non-profit municipal utility owned by the people it serves. **A higher cost plant does not result in lower profits for SMUD; it results in higher electric costs for SMUD's customer-owners.**

In addition to the cost benefit, the proposed recirculating wet cooling system provides discharge water for local downstream benefits to fish, riparian habitat, groundwater and agriculture. None of the alternatives provide this benefit, including the reclaimed or

brackish water alternatives. Recirculating wet cooling using FSC water is the most fuel-efficient choice by far among all cooling methods. Energy losses of up to 41.4 MW were calculated for alternative cooling methods. Recirculating wet cooling using FSC water has the least impact on the environment among all cooling methods and water sources in terms of air emissions, biological resources, cultural resources, socio-economics, traffic and transportation, land use, visual resources and noise.

The following Table ES-1 is a summary of the major cooling alternatives and alternative water sources in comparison to the proposed recirculating wet cooling option using FSC water.

TABLE ES-1. Comparison of Environmental Impacts of Alternative Cooling Methods and Water Sources to Proposed Recirculating Wet Cooling			
	Dry Cooling	Reclaimed Water / ZLD	Groundwater
1. Air Quality	Generates less PM10 and drift with no cooling towers. However, gap in power production needs to be replaced by additional generation, which is generally older generation or peaking units. Both have increased NOx, SOx, PM10, and CO emissions, depending on alternate sources of power.	Drift and PM10 from cooling towers would be greater depending on quality of source water. Drying drum and crystallizer may increase air emissions slightly.	Pumps would be required to obtain groundwater. If electric pumps are used, they increase parasitic load. Use of diesel pumps would create additional air emissions.
2. Biological Resources	Requires much greater area (i.e., 2.5 acres vs. 1 acre), and therefore greater potential for adverse impact to biological resources through habitat conversion. Elimination of water pass through reduces benefits to downstream uses such as fish, riparian habitat, recharge of groundwater, and water for agriculture.	Reduced water use may have indirect benefit to biological resources over use of surface waters; however, effluent from reclaimed water is not suitable for discharge to surface water, and would not support downstream beneficial uses and cannot be returned to wastewater treatment plant (WWTP). Construction of a recycled water pipeline has the potential to disturb biological resources such as vernal pools and protected species.	Groundwater quality is not as good as surface water, requiring additional pretreatment. Possibly would result in larger quantity of water required because it could not be cycled in cooling tower as much. Would not be able to be discharged to surface waters, reducing flows in Clay Creek, which may affect riparian habitat and protected species. Discharge would require use of a ZLD system.

**TABLE ES-1.**

Comparison of Environmental Impacts of Alternative Cooling Methods and Water Sources to Proposed Recirculating Wet Cooling

	<b>Dry Cooling</b>	<b>Reclaimed Water / ZLD</b>	<b>Groundwater</b>
3. Cultural Resources	Requires much greater land area (i.e., 2.5 acres vs. 1 acre), and therefore, has slightly greater potential to adversely affect cultural resources. The difference in power generated by a dry-cooled plant must be made up by other facilities, which may indirectly increase the area dedicated to power generation.	Would require construction of a 26-mile-long water line, which would have additional potential impacts to cultural resources	No foreseen effect if a ZLD system is used for wastewater discharge. If wastewater were discharged to publicly owned treatment works (POTW) would require additional pipeline construction with potential to impact additional cultural resources.
4. Land Use	Much larger size, visibility and noise generated by dry cooling increases the area over which impacts affect local receptors and, therefore, has greater potential for conflict with land use compatibility. Height of ACC would require a height variance.	Would require construction of a water line requiring addition local permits. Height of brine concentrator (90 feet) may require a height variance.	If ZLD system is used for the wastewater, the brine concentrator (90 feet tall) may require a height variance.
5. Noise	The overall noise levels would increase. ACCs are typically a minimum of 5 to 8 dBA higher at the far field distance of 400 feet than a wet cooling tower. In addition, a wet cooling tower would make use of about 18 fans with an ACC requiring about 80 fans. Also, due to site constraints, Phase 2 ACC would be located closer to existing residential uses.	Possible increase in noise due to increase in equipment.	Possible increase in pump noise.
6. Public Health	No difference in direct adverse impacts to public health. However, additional power produced by other facilities may produce adverse public health impacts due to higher emissions.	Recent concerns have been voiced over endocrine disrupters and other pathogens becoming airborne from the use of reclaimed water in cooling towers.	No foreseen public health impacts
7. Worker Health and Safety	No significant difference.	No significant difference.	No significant difference.

**TABLE ES-1.**

Comparison of Environmental Impacts of Alternative Cooling Methods and Water Sources to Proposed Recirculating Wet Cooling

	<b>Dry Cooling</b>	<b>Reclaimed Water / ZLD</b>	<b>Groundwater</b>
8. Socio-economics	Would create some additional construction jobs required to install the ACC. No additional impact to public services.	Construction of a 26-mile-long recycled water line would create several more temporary construction jobs and would indirectly provide a short-term benefit from the purchase of additional materials to construct the pipeline. No additional impact to public services.	No foreseen socio-economic impacts
9. Agriculture and Soils	Requires much larger area, and, therefore, has greater potential for conflict with objectives of agriculture and soils resources.	Construction of a 26-mile-long pipeline would create the potential for additional soil erosion and temporary impacts to agricultural production.	Use of groundwater could result in lowering the groundwater table adversely affecting other agricultural users in the vicinity.
10. Traffic and Transportation	Requires shipment of additional materials and additional workers, causing an increase in truck traffic and construction worker traffic. During operations, would not require use of cooling tower water treatment chemicals; however, an increase in maintenance and deliveries would potentially increase truck traffic.	Would create some minor traffic impacts from the construction of the additional waterline. In addition, the ZLD system creates approximately 20 to 48 tons per day of waste salt (depending on water source and level of operations) resulting in substantial additional truck traffic and potential conflict with transportation goals.	If ZLD system were required for disposal of the wastewater, the ZLD system would create significant amounts for waste salt daily (20 to 48 tons/day) for disposal. This would result in additional truck traffic.

**TABLE ES-1.**

Comparison of Environmental Impacts of Alternative Cooling Methods and Water Sources to Proposed Recirculating Wet Cooling

	<b>Dry Cooling</b>	<b>Reclaimed Water / ZLD</b>	<b>Groundwater</b>
11. Visual Resources	<p>Structures are substantially larger and taller (100-120 ft) and, therefore, more visible. Structures have greater contrast to background because of height and color, which is generally painted a non-reflective gray or brown. Will create a significant visual impact, as the top 30 feet of the structure appears as a solid wall.</p> <p>Produces no visible plume during operation that would contribute to visible impacts; however, wet cooling tower plumes are only visible during cool, high-humidity days.</p>	<p>Would add a brine concentrator (90 feet tall) that could require a height variance.</p>	<p>If a ZLD system is used for the wastewater stream, the system adds a brine concentrator (90 feet tall) that could require a height variance.</p>
12. Hazardous Materials Handling	<p>Requires slightly less use of hazardous materials, because there is no requirement for acid, caustic and chlorine, which are typical treatment chemicals for cooling towers. Potential for adverse impacts from emissions, accidental release, or transport of these chemicals is slightly less.</p>	<p>If salt product is non-hazardous, no difference. However, if salt product were hazardous, would create additional transportation of hazardous waste products and increased burden on hazardous waste landfill sites. Would also require the transport of additional chemicals for use in the ZLD process and equipment cleaning.</p>	<p>If groundwater quality requires treatment, use of additional chemicals would be required. If ZLD system is used for wastewater, salt product could be hazardous or not depending on groundwater quality. In addition, use of ZLD systems require the transport of additional chemicals for use in the ZLD process and equipment cleaning.</p>
13. Waste Management	<p>Generates less waste from water treatment chemicals. However, larger size of fans and cooling structures generates more waste during construction. Regular plant maintenance including wash-down of cooling fins generates additional waste products.</p>	<p>Creates approximately 20 to 48 tons per day of waste salt, (depending on water source and level of operations) resulting in need for substantial disposal capacity.</p>	<p>If ZLD system is used, depending on the groundwater quality, this system could generate 20 to 48 tons/day of solid waste for disposal, resulting in need for substantial disposal capacity.</p>

<b>TABLE ES-1.</b> Comparison of Environmental Impacts of Alternative Cooling Methods and Water Sources to Proposed Recirculating Wet Cooling			
	<b>Dry Cooling</b>	<b>Reclaimed Water / ZLD</b>	<b>Groundwater</b>
14. Water Resources	Would reduce consumptive water use from approximately 5,000 acre-feet per year to approximately 100 acre-feet per year. Water reduction does not support beneficial uses of effluent by riparian and aquatic resources downstream, in addition to recharge of the groundwater.	Reserves use of high quality water for potable uses and agricultural uses.  Requires additional construction of water line that has greater potential for conflict with water resources such as streams and rivers.  Would not support beneficial uses of effluent by riparian and aquatic resources downstream, in addition to recharge of the groundwater.	Groundwater basin is already in an overdraft condition. Would greatly increase overdraft and reduce water table adversely affecting agricultural uses. Also, does not support beneficial uses of effluent by aquatic resources downstream.
15. Geological Hazards and Resources	Cooling structures are taller, and therefore, more subject to damage from geologic shaking. Uses much larger area, with potential for conflict with mineral resource uses.	Requires additional construction for water line that has greater potential for conflict with geological resources. ZLD structures are taller, and, therefore, more subject to damage from geologic shaking.	If ZLD is used for the wastewater, the ZLD structures are taller, and therefore, more subject to damage from geologic shaking.
16. Paleontological Resources	Requires much greater area, and, therefore, has greater potential for adverse impact to paleontological resources.	Requires additional construction for water line that has greater potential for conflict with paleontological resources.	No foreseen paleontological impacts

This comparison matrix illustrates that there are many significant environmental impacts associated with alternative forms of cooling.

To further its efforts, SMUD sought independent confirmation of its research and findings. SMUD findings are consistent with USEPA conclusions in its recent ruling discussing alternative cooling systems and impacts related to water intake. In terms of plant efficiency, economics, air emissions, land use and other non-aquatic environmental impacts, alternatives to recirculating wet cooling were found to have significant faults.

Addressing dry cooling, the USEPA writes, "Given the performance penalty of dry cooling versus wet cooling, the incremental air emissions of dry cooling as compared with wet cooling, provide additional support for why EPA is rejecting dry cooling. Dry cooling technology results in a performance penalty for electricity generation that is likely to be significant under certain climatic conditions."

The USEPA concludes, “These additional non-aquatic environmental impacts (in the form of air emissions) further support EPA’s determination that dry cooling does not represent best technology available for minimizing adverse environmental impact on a national or region-specific basis.”

The USEPA reports that some commenters in favor of dry cooling contest that the cost of the technology is clearly not wholly disproportionate to the environmental benefit gained, and further state that “a 1 to 2 percent loss for the sake of greater protection of water resources is comparable to other efficiency penalties EPA requires of the electric industry for reductions in NO<sub>x</sub> and SO<sub>2</sub> emissions.” The USEPA editorially responds to these claims by writing, “The performance penalties of dry cooling systems play a significant role in EPA’s decision to reject dry cooling as the best technology available.”

Addressing hybrid, or wet/dry cooling systems, the USEPA writes in its ruling, “EPA considers hybrid cooling systems not to be adequately demonstrated for power plants of the size projected to be within the scope of the rule. As such, EPA has not adopted the technology as a component of the best technology available requirements of today’s rule.”

***Given SMUD’s findings, which were confirmed by USEPA’s independent analysis, recirculating wet cooling using Folsom-South Canal water is clearly the best choice for CPP.***

## 1.0 INTRODUCTION

### 1.1 Power Plant Operation

A modern “combined-cycle” plant such as CPP uses two power cycles to extract the highest efficiency possible from the natural resources it uses. The first cycle is the combustion cycle. CPP will use natural gas since it is the cleanest burning fossil fuel available in large quantities. The natural gas is mixed with air and combusted in the combustion cans of a gas turbine. The expanding gas resulting from the combustion spins the turbine. Hot combustion gases are then exhausted, emissions are reduced, and the gases travel through stacks to the atmosphere. A shaft connects the turbine to a generator that converts the mechanical power to electrical energy. A plant that uses combustion turbines without waste heat recovery is called a simple-cycle plant. Many older plants and those used during periods of high demand (called peaker plants) are usually simple-cycle plants. These plants generally do not use water in their process. However, the highest achievable efficiency of these simple-cycle plants is only in the mid-30 percent since the benefit of the hot exhaust gases [about 900 degrees Fahrenheit (°F)] is simply emitted to the atmosphere without further conversion to energy.

A highly efficient combined-cycle plant (as proposed for CPP) extracts the most benefit from the heated exhaust. Large tube banks are installed in a heat recovery steam generator (HRSG) located at the outlet of the combustion turbine. Water flows through the tubes and is converted into steam by the heat from the combustion turbine exhaust gases. The steam is piped to a steam turbine where it spins the turbine blades to produce power much like the combustion turbine. Once the steam leaves the turbine it goes to a condenser where the steam is converted back into water and pumped through the boiler tubes once again. In order for this type of cycle to work, the laws of thermodynamics require the steam to be condensed. The steam is condensed by allowing it to come into contact with tubes in a secondary system containing circulated water. The water in the tubes extracts heat from the steam and then this water itself must be cooled. The most energy-efficient method to do this at CPP is to allow the heated water to be sprayed into a cooling tower and come into contact with air. This makes use of evaporative cooling at wet bulb temperatures. When air is forced upward by fans and comes into contact with the falling water, some of the heated water is evaporated, while the rest is recirculated once again through the system. Overall, water used to makeup evaporation losses is generally 3 percent or less of the recirculating water flow. When the equipment is adjusted properly, combined-cycle plant efficiencies can run above 50 percent when comparing the heat of the fuel to the net energy produced.

Alternative technologies are available to condense the steam used in the steam cycle. Some of these technologies use closed loop systems that reduce water consumption. However, these forms of technology do not take advantage of the lower wet bulb temperatures and require extra energy to perform essentially the same tasks. One form of alternate cooling is often called “dry cooling” and makes use of an air-cooled

condenser (ACC). In this arrangement, the steam turbine exhausts steam into the ACC via a large diameter duct. Then, the steam flows from the main exhaust duct and into the inside of finned tubes where the steam is condensed. Condensed steam flows by gravity into condensate collection headers and then into the ACC condensate receiver. Unlike recirculating wet cooling where the secondary water contacts the air, the condensing steam flows through finned tubes that directly contact the air. Only the cooling capacity of the dry bulb temperature of the surrounding air can be tapped, hence large volumes of air must pass over the fin tubes. Since air is a very poor heat transfer agent as compared to water and in order for the ACC to condense the steam and cool the condensate sufficiently, the surface area and hence, the ACC, must be very large. Due to the sheer size, large fans must be used to force air across the fins to cool the surfaces. These large fans and condensate pumps require large horsepower motors to operate and significantly increase the plant's parasitic electrical load. SMUD calculated that up to 80 fans could be required for CPP, and fan motors can be rated as high as 200 horsepower. This in turn reduces overall plant efficiency. There is also a greater efficiency penalty due to an increased backpressure in the condenser associated with dry cooling. This inefficiency increases during hot summer months when consumer energy demand is the greatest. Various studies by USEPA show the loss in efficiency can be as much as 4.3%, and other studies show the loss in efficiency can be much greater. One study cited by the USEPA shows the energy penalty during peak summer conditions can exceed 12% [316(b) TDD, p. 4-2]. The increase in back pressure can also cause steam to condense on the turbine blades, resulting in damage to the blades, reduced output, and increased maintenance costs.

## **1.2 Local Voltage Support**

Local voltage support is also relevant in the discussion since an alternative to building a new power plant is importing power. In order to import additional power the District would need to build new transmission lines. There is a regional need for local voltage support within the SMUD service area. Simply stated, a power plant acts as a pump to boost voltage (pressure) in the transmission lines serving a regional or local service area. Without the local benefit of a baseload power plant to meet growing regional demand, system reliability can be compromised. Fluctuations in voltage could damage customer equipment and cause service outages. The existing switchyard and transmission lines emanating from Rancho Seco support established load centers and substations that are integral to the region and SMUD's service area. It is anticipated that existing transmission lines could serve the area well into the future with the proposed baseload generation providing needed support voltage. Failure to site a power plant in the region to meet increased customer demands would result in the necessity of clearing new corridors and building new transmission lines. If CPP does not provide a measurable overall benefit to the community and the environment and does not establish a cost-effective benefit for SMUD customer-owners, the project could not be built. The likely alternative is to establish new corridors and build high-voltage transmission lines from other areas.

Major transmission line corridors have their own impacts to the environment. Establishing a corridor involves acquisition of right-of-ways and land purchases, clearing brush and other vegetation, disturbing soil and potential upset of biological, cultural, and paleontological resources. The most likely corridors still available in Sacramento County generally include agricultural land, rural areas, and other open space. Transmission lines through agricultural areas can disrupt crop-dusting activities, and building lines in open spaces that normally attract aviary species can result in increased aviary collisions. Major transmission lines also have an effect upon visual resources and the overall landscape.

### **1.3 Balance of Natural Resources**

Each cooling alternative intended to conserve at least one natural resource can have rippling effects that cross over into other environmental areas. The most desirable cooling method will minimize impacts to a majority of affected areas to achieve an overall balance for the environment. An example of a failed experiment that conserved one resource at the expense of another is the use of methyl tertiary butyl ether (MTBE) in gasoline to reduce air emissions. Unfortunately, MTBE has also been shown to taint water bodies and groundwater, therefore resulting in a negative net benefit to the environment. The same is true when studying alternative forms of cooling. A balance must be maintained among all environmental resources to ensure that a perceived benefit in one area does not have an overall negative net benefit when all resources are taken into consideration.

The most efficient use and balance of all natural resources, including fuel and water, are at the root of this analysis. This report studies the overall environmental effects of the various cooling alternatives available. Thorough discussion and quantified costs for each alternative cooling technology or water resource are presented in Section 2. USEPA documents were researched to confirm data, costs and environmental impacts through an independent source. Results of this research are presented in Section 3. This report also provides a primer for SMUD's proposed water use as it relates to other uses in the region and the Central Valley. This information is presented in Section 4 and establishes relative benchmarks for proposed CPP water quantities. A summary of conclusions is presented in Section 5.

## **2.0 ALTERNATIVES ANALYSIS**

### **2.1 Proposed Wet Cooling Tower System with Discharge of Treated Wastewater into Clay Creek.**

#### **2.1.1 Description of Proposed Configuration**

CPP is designed to be highly efficient to minimize environmental impacts while making the best use of natural resources and minimizing costs to SMUD's customer-owners. CPP proposes using a power plant system consisting of a shell and tube steam condenser, a mechanical draft wet cooling tower, and a water circulating system. The proposed design for condensing the exhaust steam from the steam turbine is the standard shell and tube condenser with the steam condensing on the outside of the tubes due to the heat absorbed by the water flowing through the tubes. Steam turbines generate more power if the temperature and pressure in the condenser is lower since the exhaust steam exiting the turbine can expand further, thus doing more work to generate power. A lower exhaust pressure is achieved by flowing cooler water through the inside of the condenser tubes. In the microclimate at CPP, the dry air (low relative humidity) during a typical hot day allows the production of cool water through the use of wet mechanical draft cooling towers. Cooling water from the condenser is circulated back to the cooling tower where a portion of the water is evaporated to cool the water before returning to the condenser. The lower the ambient relative humidity, the cooler the return water is following evaporation.

The CPP condenser and wet mechanical cooling tower combination is a very typical system employed in power plants with similar microclimates due to its ability to produce cooler water, which results in greater power output in the steam turbine. Consequently more power is produced than with other alternative systems that are employed under similar circumstances. Water is continually added to the cooling tower to replace water lost due to evaporation and water that is drained off to maintain proper cooling tower water chemistry. CPP has proposed the use of FSC water (from the American River) for make up to the cooling towers. This water is particularly well suited for the project due to the existing delivery system (for the decommissioned Rancho Seco Plant (RSP)), the high quality of the water (which requires very little treatment prior to being used), and the small amount of water that needs to be drained off (referred to as "blowdown") to maintain proper chemistry within the water circulating through the cooling tower.

SMUD expects the number of cycles and amount of blowdown will be controlled by the expected NPDES requirements for limiting the total dissolved solids (TDS). This TDS limit will most likely be reached before other limiting water chemistry criteria. The next most likely operating cycle restriction is expected to be the allowable ppm of dissolved silica in the cooling tower water.

This cooling system is a well-proven system used throughout the power generation industry and, as a consequence, the proper design and operational requirements are fully understood. After proper treatment, the current design of the CPP water system

ultimately discharges the blowdown from the cooling towers into Clay Creek. This creek is normally dry for many months of the year at the point where the treated wastewater will discharge into the creek. To meet the expected NPDES requirements, water will pass through a treatment system that will remove any residual chlorine, pass through a clarifier (or similar system) to remove solids and some of the heavy metals as required, and finally through a gravity filter for final clarification. Systems similar to this are widely used to economically treat wastewater and achieve the required water quality prior to discharge into creeks or streams. Shortly after discharging into the creek the water will join with the water currently being discharged by the RSP into Clay Creek. These two water sources will provide the only source of water for Clay Creek during many months of the year and provide water downstream for aquatic life and agricultural use. Ultimately, via Hadselville Creek and Laguna Creek, this water will be a source for the Cosumnes River, which it joins prior to entering the Cosumnes River Preserve. Thus, the water discharged from CPP becomes recycled water that provides useful benefit after being used by the CPP. During the winter months when the creek contains water due to storm runoff, the CPP wastewater discharged into the creek will supplement the creek water in volume and will also reduce the sediment (through dilution) in the creek at that point. The use of the existing water transport system by the CPP will contribute to the water delivery system maintenance that supplies much of the water in Rancho Seco Reservoir.

Although there is a downstream benefit for water discharged into Clay Creek, there is no additional definable benefit of the water that is evaporated. There will be a very slight increase in humidity downwind of the cooling towers, but this increase is insignificant beyond a short distance.

### **2.1.2 Baseline Noise**

Noise from wet cooling towers arises from both the falling water noise and the exhaust fan noise. It is expected that noise from the cooling towers will be a minor contribution to the overall plant far field noise levels. Location of the towers on the eastern edge of the plant as well as the generally lower noise levels of wet cooling towers compared to the other equipment on site helps minimize noise to the sparsely populated community west of the plant.

### **2.1.3 Baseline Power Consumption**

This cooling water system requires power for operating the air fans (one in each tower cell) and the water pumps to circulate the cooling water from the tower to the condenser and back again. Since the power to operate this system is power that is produced by CPP, but cannot be used by SMUD customers (since it is used at the site) it is referred to as parasitic or station service power. Some power can be conserved on cool days by turning off fans when all the cells do not need to be operated to achieve the desired amount of cooling. The circulating water pumps normally operate at full flow under all ambient conditions so there is no potential for power savings by shutting down a

circulating water pump. This is due to the heat transfer characteristics of the shell and tube steam condenser.

#### **2.1.4 Baseline Cost**

For the CPP, the basic wet cooling tower system is estimated to cost approximately \$10.0 million installed including the circulating water pumps. It is expected that the two towers (one for each phase of the project) will be eight or nine cells each, depending upon final vendor selection. In addition, the condenser and circulating water piping is estimated to cost \$6.4 million installed. Over the 30-year design life of CPP the maintenance and operating costs of the towers are expected to have a Net Present Value (NPV) of \$7.1 million while the condenser is expected to have a maintenance cost of \$2.5 million NPV. Part of the wet cooling tower system is the wastewater treatment system used to treat cooling tower blowdown. This system has an estimated installation cost of \$3.3 million and an NPV of operating and maintenance (O&M) costs of \$7.0 million.

The total system cost as described was estimated to be \$19.7 million with the NPV of the O&M costs of \$16.6 million, for a total of \$36.3 million. Since this is considered to be the base design system, parasitic loads for other alternatives will be compared to this system and, therefore, no loss of export power is included in the above estimates. A summary of the cost calculations for each alternative is provided in Appendix B.

### **2.2 Air-cooled Condenser (Dry Cooling)**

#### **2.2.1 Description of Alternative**

As an alternative to the wet cooling tower/condenser system described above, an air-cooled condenser (ACC) system was evaluated. An ACC performs both the function of the condenser and the cooling tower. In this arrangement the steam turbine exhausts steam directly into the ACC via a large diameter duct. Then the steam flows from the main exhaust duct into branch ducts and into externally finned tubes where the steam is condensed. An ACC does not use evaporative water as a cooling mechanism; it uses the temperature of the ambient air as a heat sink. By passing large amounts of air over the outside of the finned tubes heat can be transferred away to cool and condense the steam on the inside of the finned tubes. In this system the temperature of the condensing steam is usually selected to be 40 °F above the ambient air temperature. The 40 °F differential is selected to optimize power plant efficiency and minimize capital costs of the ACC. One purpose of CPP's proposed wet cooling tower configuration is to achieve the highest cost-effective output on a hot day (design for 104 °F ambient temperature) when power demands on the SMUD system are greatest. Taking into account the hot microclimate at CPP, an ACC results in a steam turbine exhaust temperature of 144 °F or an exhaust vacuum of 6.4 inches HgA.

### 2.2.2 Energy Consumption Impact

At the design condition of 104 °F ambient, the parasitic load for the ACC is 1,215 kW greater than the wet cooling tower system; however, the loss in net plant output is 41,638 kW or 4.2% of the total plant output (the size of a small simple-cycle peaker plant). This is due to the higher steam turbine exhaust pressure and temperature and the resulting loss of efficiency of the steam turbines. Even with a lower ambient temperature (not uncommon in the CPP microclimate) of 80 °F, the net plant loss of output is still 40,450 kW or 4.0% of the total plant output. **This is a significant loss during hot periods of the year when there can be a substantial demand for power by SMUD's customers.** Unlike the wet cooling tower, there is no benefit to a low relative humidity for ACC performance improvement, and consequently, the ACC cannot take advantage of the dry microclimate at CPP.

### 2.2.3 Land Use Impact

By the nature of the ACC, it must be physically located near the steam turbine to minimize pressure loss in the duct connecting the ACC to the steam turbine. A site plan illustrating the use of an ACC is presented as Figure 1. A higher pressure drop in this duct created by any additional duct length significantly reduces steam turbine power output (efficiency) and, as a consequence, the use of dry cooling would dictate the plant arrangement. This restriction may not allow the most economical arrangement of the overall power plant to be used at the CPP site particularly due to the preferred location of the CPP switchyard. Additionally, the ACC requires more space than the wet cooling tower counterpart. An ACC plot area is 52,775 square feet versus a wet tower plot area of 22,540 square feet for each phase, for a plant total of 105,550 square feet for the ACC versus 45,080 square feet for the wet tower. Thus the ACC requires more than *double* the plot area of the wet cooling tower or an additional 1.39 acres. The added laydown and construction area would require disturbing more soil. It is not expected that the ACC system could be incorporated into the CPP site without significant expansion into the creek and ephemeral stream system. In addition, the height of the ACC, at 100 to 120 feet tall, may require a height variance from Sacramento County.

### 2.2.4 Visual Impact

The height of the ACC will be between 100 –120 feet high while the proposed wet cooling tower fan shrouds are expected to be in the range of 40 – 45 feet high depending upon final vendor selection. The ACC structures would clearly dominate the visual appearance of the plant due both to their size (230 feet x 230 feet) and their height. The top 30 feet actually appears as a solid wall due to the wind louvers or panels. A conceptual simulation of the ACC configuration is presented as Figure 2. ACC construction would also result in significant disturbance to the area outside the proposed plot area due to the increased size and location restrictions. It is unclear how the ACCs can be included in the design and meet other objectives regarding disturbance of surrounding creek beds and vernal pools.

Insert Figure 1, Site Plan with ACC

Insert Figure 2, ACC Visual Simulation

### 2.2.5 Noise Impact

Due to the height and the number of fans, the noise from the ACC is expected to contribute a minimum of 5 – 8 dBA far field noise at 400 feet from the structures. This will have to be analyzed in combination with the contributions from the remaining equipment at the plant. However, if additional noise mitigation is required, it is expected to add an additional 20 to 25 percent to the cost of the ACC.

### 2.2.6 Maintenance Impact

ACC cooling systems require attentive maintenance to keep cooling performance at a peak. When the fins on the ACC tubes become dirty, it is necessary to clean them using large quantities of water applied under pressure to restore ACC performance. Due to the CPP location in a dry area surrounded by vegetation, pollen and other air borne contaminants may require the fins to be cleaned two or three times more frequently on an annual basis.

If an ACC were to be used, then the plant auxiliary cooling system would have to be accomplished by the addition of air-water heat exchangers, that function much like a car's radiator and are also known as "fin-fan coolers." The ACC is not suited to provide auxiliary cooling. This would also increase the parasitic load for the power plant as a whole, thereby reducing the power available for supply to the grid. No accounting for this increased parasitic load to support the plant auxiliary cooling system, noise contribution, or additional capital and operating cost has been included in any of the estimates for this study.

### 2.2.7 Cost Impact

Cost is a significant consideration when evaluating ACCs. The capital cost of the ACCs for the CPP is estimated to be \$62.5 million for the installation of both ACCs. (This cost estimate is based on the output of an engineering cost estimation program adjusted for California conditions and confirmed by comparison with a budget proposal from an ACC vendor for a similar unit. See Appendix B.) This is more than *three times the cost* of the wet cooling tower system having an estimated installed cost of \$19.7 million (includes wet cooling tower, condenser and piping, and wastewater treatment system). Comparing the estimated operating and maintenance costs of the ACC to the wet cooling tower system, the NPV cost for the ACC is \$30.6 million versus \$16.6 million for the wet cooling tower system. O&M costs included chemicals and water for the wet cooling tower system (which includes the condenser and wastewater treatment) and for the ACC included the cost of the additional parasitic power consumed by the ACC over the wet cooling tower system. It does not include the lost revenue due to the decreased plant output resulting from the reduced steam turbine output (lower efficiency).

The export power loss for the CPP operating with an ACC versus a wet cooling tower is approximately 40,450 kW or greater for ambient temperatures above 80 °F. Based on weather data from McClellan AFB in Sacramento, this is expected to occur at CPP for at

least 13% of the time on an annual basis. This is also the time when power is the most expensive. The estimated NPV of the lost revenue based on 3% inflation, 30-year life, a 6% discount rate, and an initial power price of \$85/MWhr is \$75.4 million.

Another cost consideration is the increased use and cost of fuel due to lower efficiency and increased parasitic loads. Over a 30-year plant life, a conservative approximation of \$202 million is calculated for fuel cost increases related to the energy penalty. This assumes a fuel cost of \$4.00/MMBtu, which can be expected to increase in the 30-year period.

Adding the cost of installation, O&M, loss in export power capacity (or conversely, importing replacement power), and added fuel cost, the total for the ACC alternative is about \$370.5 million.

## **2.3 Hybrid Cooling (Combination of Wet Cooling and Dry Cooling Systems)**

### **2.3.1 Description of Alternative**

Hybrid cooling represents the inclusion of both a wet cooling tower system and an air-cooled system sharing the cooling duty for the condensing of the steam turbine exhaust steam. Each of these systems is smaller than their standalone counterparts. The decrease in water consumption is unclear, but between 40-45% has been claimed by vendors without site-specific analysis. Steam from the turbine condenses simultaneously in both systems with the actual distribution of the condensing steam dependant upon the ambient conditions and the operating mode of each system. Some other cooling systems that employ a single system of wet/dry cooling towers are normally used for plume abatement and are not intended for saving water. The CPP design point for a hybrid system was selected by the hybrid system vendor to be 80°F. This design temperature represents the point where the hybrid system utilization would result in roughly halving the annual water consumption of a wet cooling tower at CPP.

### **2.3.2 Energy Consumption Impact**

As with the ACC alternative, there would be a significant energy penalty associated with a hybrid cooling system. The estimated annual average penalty is 2.4%, with peak energy penalties of 3.5% when SMUD customer demand is at its highest.

### **2.3.3 Land Use Impact**

As with the ACC design the hybrid design would dictate the arrangement of the equipment in order to accommodate the ACC portion of the hybrid system. The total plot area of the hybrid system is 51,620 square feet or about 10 % greater than the wet cooling tower design (with a design temperature of 104 °F) and about half the ACC-only design. While the hybrid ACC is smaller than the ACC-only unit, it is expected that the impacts on construction and schedule would be similar if not greater than the ACC-only system. This is based on the hybrid's complexity and design restrictions due to having

two systems as opposed to a single system. It is not expected that the hybrid system could be incorporated into the CPP site without significant expansion into the creek and ephemeral stream system.

### **2.3.4 Visual Impact**

Visual impact for the hybrid system would be somewhat less than the ACC-only system due to a lower height (90-100 feet versus 100-120 feet) and due to the size of the hybrid ACC being only about half the area of the ACC-only unit (i.e., about 0.7 acre more than the wet cooling system). However, the hybrid ACC would still be the dominant visual feature of the CPP and the skyline.

### **2.3.5 Noise Impact**

Noise from the hybrid system is expected to cause an impact similar to the ACC-only system and if noise mitigation were required to meet the levels of the wet-cooling system the minimum capital cost increase would be an estimated \$5.0 million.

### **2.3.6 Maintenance Impact**

Similar to the ACC-only alternative, added maintenance would be expected in order to keep the ACC fins clean in order to achieve the highest ACC performance. This includes washing the fins with high pressure water to displace dust, pollen or other debris, creating additional wastewater for disposal.

### **2.3.7 Cost Impact**

The estimated installed capital cost of the hybrid system is \$36.7 million (including required smaller wastewater treatment system), or an increase of \$17.0 million over the wet cooling tower system. Estimated operating and maintenance costs for the hybrid system is \$18.4 million NPV versus \$16.6 million (see Appendix B).

The hybrid system would draw less parasitic load than the ACC-only system, but more than the wet cooling tower system. Compared to the wet cooling tower system this difference would typically range from 1,500 kW to 1,700 kW depending upon the ambient temperatures. However, the net plant output would drop by 24.3 MW at 80 °F and 35.2 MW at 104 °F. This loss of net power exported during the hot season is estimated to result in the NPV of lost revenue of \$50.3 million over the 30-year life of the plant.

Another cost consideration is the increased use and cost of fuel due to lower efficiency. The average increase in heat rate is 178 Btu/kWh. Over a 30-year plant life, a conservative approximation of \$174 million is calculated for fuel cost increases related to the energy penalty. This assumes a fuel cost of \$4.00/MMBtu, which can be expected to increase in the 30-year period.

Adding the cost of installation, O&M, loss in export power capacity (or conversely, importing replacement power), and added fuel cost, the total for the Hybrid ACC alternative is about \$279.4 million.

## **2.4 Reclaimed Water**

### **2.4.1 Description of Alternative**

As an alternative to using FSC water, the use of reclaimed water (waste treatment plant effluent) from either the Sacramento Regional Wastewater Treatment Plant (SRWTP) or the Galt Wastewater Treatment Plant (GWTP) has been suggested. Based on contact with the SRWTP, it is not apparent that there is sufficient Title 22 effluent available that is not already committed by the authority to meet customer and statutory requirements. Secondary effluent (non-Title 22 water) also has quality, availability, and contractual risks that make it an uncertain commodity for which to plan a major project. The total 2.0 MGD throughput of the GWTP is insufficient to cover the requirements for raw water at CPP. The availability and quality of the GWTP effluent is also unknown at this time.

### **2.4.2 New Water Pipeline Required**

If reclaimed water were used, then new water lines would have to be constructed having an estimated length of 26 miles for the SRWTP and 17 miles for the GWTP. It is not expected that the SRWTP wastewater line could be constructed along the same route as the natural gas line due to separation distances, future maintenance, and the different types of construction involved.

### **2.4.3 Zero-liquid Discharge Required**

Using reclaimed water from either plant would require a zero-liquid discharge (ZLD) system, which is discussed in Section 2.7. It is also expected that additional treatment would be required for the effluent from either WTP but that treatment system has not been included in this economic evaluation. Additionally, it is expected that both WTPs would have higher silica content than FSC water and, consequently, the achievable cycles will most likely be reduced thereby increasing total water consumption. This water would otherwise have beneficial use downstream of each WTP (supporting aquatic life, agriculture, and riparian habitat). Instead, a ZLD system intentionally evaporates water and leaves a salt byproduct, with no beneficial downstream uses for the water.

### **2.4.4 Cost Impact**

To pump the water from the SRWTP, a pump station would need to be built at the SRWTP facility. Based on a 26-mile reclaimed water line, the estimated construction cost is \$22.7 million with an additional \$2.8 million for easements. The cost of the required ZLD system is estimated at \$13.0 million and the NPV of the operating and maintenance costs is estimated at \$19.0 million over the 30-year life (see Appendix B).

This amount does not include any charge for the water since it has not been established; however, in the California water market, it is expected that there would be a charge for the reclaimed water since other uses would be precluded (such as landscaping, agriculture, etc.) The ZLD system also consumes a reasonably high amount of parasitic power estimated at 1.1 MW. Over the 30-year plant life, the NPV of this electrical consumption is estimated at \$6.1 million. This again supports the observation that a zero discharge system is not well suited as a water saving investment. The total project cost for reclaimed water from the SRWTP is estimated to be \$63.6 million. This is added to the cost of wet cooling (minus the clarifier) for a grand total of \$89.9 million.

For the following cost estimate of a potential pipeline, *it was assumed that there would be sufficient volume available from GWTP*. In order to pump reclaimed water from the GWTP, a pump station would need to be built at the GWTP facility. Based on a 17-mile line, the GWTP reclaimed water line estimated construction cost is \$11.2 million and an additional \$1.8 million for easements. As for the SRWTP, the cost for the zero liquid discharge system is estimated at \$13.0 million and the NPV of the operating and maintenance costs is estimated at \$18.3 million. As with the SRWTP, the cost of the water, if it were available, has not been established; however, it is expected that there will be a charge for the reclaimed water. The ZLD system also consumes a reasonably high amount of parasitic power estimated at 1.1 MW. Over the 30-year plant life, the NPV of this electrical consumption is estimated at \$6.1 million. This again supports the observation that a zero discharge system is not well suited as a water saving investment. The estimated total project cost for supplying GWTP reclaimed water to the CPP is \$50.5 million. This is added to the cost of wet cooling (minus the clarifier) for a grand total of \$76.5 million.

It is expected that the time required for developing a route for a water supply line from either WTP and then to design the system and acquire the necessary easements would become the critical path for the CPP project and may impact its ability to begin operation in the first quarter of 2005. Construction of either water line would have all the associated impacts of construction on the local communities along the pipeline route.

## **2.5 Brackish Water**

### **2.5.1 Description of Alternative**

Another alternate source of water that has been suggested is the use of “brackish water.” Brackish water is defined as water with high salinity, but not as much as the open sea. Brackish water usually occurs in a delta as water from bays and rivers are intermixed by tidal currents. The nearest source of brackish water would be from the Antioch area. A line from Antioch to the CPP would be roughly 45 miles long. Although a water analysis is not available, it is expected that the water will only be able to achieve two cycles of concentration in a cooling tower. The blowdown would have to be returned to Antioch since a zero-liquid discharge system would not only consume large quantities of power but it would generate a prohibitively large quantity (over 20 tons per hour) of

waste (salt cake) that would need to be trucked off site to landfill. This analysis also assumes that SMUD could obtain a discharge permit for the return flow or meet the requirements of a publicly owned treatment works (POTW) to take this return flow. Both the discharge permit and acceptance of the return flow are highly speculative.

### **2.5.2 New Water Pipeline and Pumping Station Required**

Approximately 45 miles of supply and return piping would be required along with a supply pumping station. The remote location of a pumping station at Antioch would require extensive remote monitoring and regular site visits by operations personnel to ensure the facility is operating properly. Also, to build any type of intake structure at the mouth of the Sacramento River at that location would be a significant engineering undertaking as well presenting permitting challenges.

Finding a route would also be very speculative given the numerous creeks, sloughs, and highways that would have to be crossed by a supply and return pipeline between Antioch and CPP. This long pipeline would also require maintenance beyond the pump station to ensure that it would be a reliable supply of water.

### **2.5.3 Cost Impact**

The estimated capital cost to construct the two pipelines (a steel lined and coated supply line and a HDPE return line) including the intake structure and pump station is \$58.0 million and the easement rights were estimated at \$4.9 million. Pumping power and NPV for operations and maintenance for a 30-year period was estimated to be \$11.6 million. The total project cost for transporting of brackish water from Antioch was estimated to be \$74.5 million. This is added to the wet cooling tower (minus the clarifier) cost of \$26 million for a grand total of \$100.5 million (see Appendix B).

Another consideration for brackish water in the cooling tower will be the high TDS in the cooling tower drift and the resulting generation of PM<sub>10</sub>. Based on a TDS of 70,000 ppm in the water and a drift of 0.0005% there will be an increase from 1.2 tpy (tons per year) to 175 tpy in the PM<sub>10</sub> released by the cooling towers. This is an extremely important observation, as it is greater than the 157.8 tpy estimated for the PM<sub>10</sub> emissions from the gas turbines.

## **2.6 Groundwater**

The District was asked to investigate drilling an onsite supply well to provide water for CPP cooling. After initial investigation of this option, SMUD determined this alternative to have a significant adverse environmental impact. AFC section 9.2.2.3.14, Water Resources, briefly discusses the overdraft or near-overdraft condition of groundwater in Sacramento County. AFC section 8.14.3.2, discusses groundwater conditions in detail. According to a 1994 SMUD study, it was found that groundwater levels near the proposed CPP have been dropping approximately 2 feet per year since 1976, with potable water at depths of 230 to 350 feet. This area is considered by Sacramento

County to be in one of the three major problem areas for groundwater overdraft in the county. Recharge areas usually exist along active significant stream channels with sands and gravels. Only limited areas near the Rancho Seco property have moderate recharge capability, and most of the site is characterized as having poor recharge capability because of clay or hardpan soils. Due to these conditions, cost estimation in the use of an onsite supply well for groundwater was not pursued. However, for thoroughness, a comparison of environmental effects is included in the Executive Summary table.

Cost aside, the environmental effect prevented SMUD from pursuing further analysis.

## **2.7 Wastewater Zero-liquid Discharge**

A wastewater ZLD system would be necessary if CPP used reclaimed wastewater from either of the two wastewater treatment plants (SRWTP or GWTP) due to the expected initially higher TDS in the treatment plants' effluent. It is expected that an NPDES permit will limit CPP wastewater TDS to 500 ppm on a monthly average basis for any wastewater discharged to Clay Creek. Additionally, blowdown could not be returned to the WTPs due to increased concentration of heavy metals and other dissolved solids, which would likely exceed their allowable limits for influent. This has been the experience for other WTPs in the state that had been contacted for other power projects. The number of cycles was determined based on the expectation that silica will govern the number of allowed cycles for cooling tower water. Based on eight cycles, there will be the potential for water savings approaching 14 percent due to the return to the cooling tower of water from the ZLD system. The capital cost for the ZLD system is expected to be \$13 million and the operation and maintenance over the 30-year life is approximately \$13.8 million depending upon the actual source of cooling tower makeup water and the chemicals required for the ZLD.

A ZLD facility also has to address the disposition of the outflow from the oil/water separators located within the plant prior to the water being put into the cooling tower basin. This is a special treatment issue for the ZLD facility that can increase costs.

For a potential savings of 949 acre-feet per year, at an initial cost of \$16/acre-foot, the NPV of the saved water is \$292,000. Compared with the cost for installation and operation, the value of the water savings is not a justification for including a ZLD system.

The ZLD system contains several pieces of equipment and forms a water treatment system requiring constant, intensive monitoring and maintenance. It commonly requires the addition of an extra staff member solely for operating and maintaining a ZLD system. Since the cost of the system noted above is only for a single train, the system would need to be kept operating to ensure water chemistry in the cooling tower water is properly maintained.

This system also consumes a large amount of parasitic power estimated at 1.1 MW. Over the 30-year plant the NPV of this electrical consumption is estimated at \$6.1 million. This again supports the observation that a zero discharge system is not well suited as a water saving investment.

Another aspect of a ZLD system is the elimination of downstream beneficial use of the water discharged into Clay Creek. This water would comply with NPDES permit requirements and would, therefore, be compatible with aquatic and agricultural use. This is the current practice for RSP discharge into Clay Creek. Water not used by agriculture ultimately joins with the Cosumnes River via Hadselville Creek and Laguna Creek.

The salt cake generated by the ZLD system would require disposal in a nearby landfill (assuming it is non-hazardous) and would constitute an estimated volume of more than 9 cubic yards per day requiring about 4 or 5 dump truck trips per week. Although not a large quantity, it does add to the burden on local landfills and the highway system for the next 30 years. The NPV of the landfill tipping fees has not been included in the cost estimate.

The estimated plot size for the ZLD system, not including a brine storage tank to handle surges, is roughly 60 feet by 70 feet. This is not an inconsequential area and needs to be located for easy access by the dump trucks hauling away the salt cake.

## **2.8 Water Recovery Through Use of a ZLD System**

Elimination of wastewater discharge from the CPP would require a ZLD system. The actual ZLD system design is heavily dependent upon the actual chemistry of the makeup water. Only by defining the water chemistry can the ZLD system be optimized. For blowdown volumes of 600 – 700 gallons per minute, these ZLD systems usually begin with a softener-clarifier that accepts all of the cooling tower blowdown and after treatment sends it to a reverse osmosis system (R/O) system. The R/O removes a large percentage of salt (TDS) from the water stream and returns 75 percent to the cooling tower as makeup. The remaining 25 percent, that now contains roughly four times the original concentration of TDS, is routed to a vapor compression brine concentrator. This brine concentrator produces two streams of water: one stream comprising roughly 20 percent of the original blowdown flow and is very high quality water that could be supplied to a deionization system for use in the facilities demineralization system or can also be returned to the cooling tower; and a second stream comprising roughly five percent of the original blowdown stream that is sent to a concentrator/crystallizer or drum drier system. The crystallizer system produces a dry salt cake for disposal.

## **2.9 Cost Summary**

The following table summarizes the costs calculated in the previous sections. More detail is presented in Appendix B.

**TABLE 2-1**  
Summary of Costs by Alternative (\$ million)

	<b>Wet Cooling (base case)</b>	<b>Air-cooled Condenser</b>	<b>Hybrid (wet/dry)</b>	<b>Reclaimed (SRWTP)</b>	<b>Brackish Water</b>
Capital Cost	\$19.7	\$62.5	\$36.7	\$64.5 <sup>b</sup>	\$88.9 <sup>b</sup>
O&M Cost (NPV)	<u>16.6</u>	<u>30.6</u>	<u>18.4</u>	<u>19.0</u>	<u>11.6</u>
Subtotal	\$36.3	\$93.1	\$55.1	\$83.5	\$100.5
Parasitic Load	\$0.0	\$75.4	\$50.3	\$6.1	\$0.0
Increased Fuel	\$0.0	\$202.0	\$174.0	\$0.0	\$0.0
Value of Water Saved	\$0.0	<\$0.29>	<\$0.15>	<\$0.15>	<\$0.29>
<b>TOTAL COST</b>	<b>\$36.3</b>	<b>\$370.2</b>	<b>\$279.3<sup>a</sup></b>	<b>\$89.5<sup>c</sup></b>	<b>\$100.2</b>

<sup>a</sup> Uses about half the water of the Wet Cooling alternative

<sup>b</sup> Includes the cost of the wet cooling system minus the clarifier = \$26 million

<sup>c</sup> Does not include cost of reclaimed water or cost of salt cake disposal.

## **3.0 USEPA RULING FOR INTAKE STRUCTURES AND COOLING SYSTEMS**

### **3.1 Introduction**

Studies and analyses from industry and regulatory agencies are useful in establishing independent viewpoints regarding various cooling options. Recent rulings lend a regional and nationwide perspective for power plant cooling systems. Analysis and documentation in a recent ruling performed by the U.S. Environmental Protection Agency, published December 18, 2001 as 40 CFR Parts 9, 122, et al., provides benchmark information for open-cycle once through cooling, re-circulating wet cooling, hybrid cooling, and dry cooling systems. The ruling is provided in its entirety in Appendix C.

The intent of the ruling is to address cooling water intake structures for new power plant facilities. That is, facilities that obtain cooling water from oceans, rivers and other water bodies. It is purported that intake structures taking in large volumes of water also entrain marine and aquatic life, or impinge aquatic organisms against screens or other devices at the entrance to cooling intake structures. Some of the power plants studied include those that are directly adjacent to oceans or rivers and use those water bodies for cooling. For example, San Onofre Nuclear Generating Station (SONGS) on the Pacific Ocean, Pittsburg and Contra Costa power plants in the San Francisco Estuary, and the Coleman Power Plant on the Ohio River are mentioned by name. These plants take in annual average flows from 337 MGD [Coleman] to more than 500 MGD [SONGS]. Several plants in the study operate with open-cycle, once-through cooling systems.

Although it is not the primary objective of the ruling to study cooling options, the ruling addresses various forms of alternative cooling such as the ones being considered by this water study. The analysis determines the “best technology available” to reduce water consumption at power plants and manufacturing facilities, while providing balance for all other environmental, or “non-aquatic” considerations, such as air quality and fuel waste. The USEPA’s ruling authorizes federal, state and tribal programs to implement the requirements of the ruling. Therefore, the ruling establishes the national benchmark for Greenfield plant cooling systems.

The final rule applies to new Greenfield and standalone facilities that use cooling water intake structures to withdraw water from waters of the U.S. and that have or require a National Pollutant Discharge Elimination System (NPDES) permit issued under section 402 of the Clean Water Act [p.65265]. In the ruling, several options were studied as alternates to cooling water intake structures. Included were dry cooling systems and wet/dry hybrid systems. These types of cooling systems were considered, studied, then rejected by the USEPA due to their environmentally damaging side effects, natural resource inefficiency, and high cost.

### 3.2 Conversion of Once Through Systems to Recirculating Wet Cooling Systems

The ruling concluded that for the purpose of entrainment of marine life or impingement of aquatic organisms, all new facilities with cooling water intake structures having a design intake flow equal to or greater than 10 MGD must reduce the total design intake flow to a level, at a minimum, commensurate with that which can be attained by a closed-cycle re-circulating cooling water system using minimized make-up and blowdown flows, similar to the type proposed for CPP. This would, for example reduce water use of a 500 MGD, once through cooled plant by 96-98% down to 10-20 MGD. Applicants with 2-10 MGD flows are not required to reduce capacity but must install technologies for reducing entrainment at all locations (CPP anticipates 7.1 MGD annual average water use with the proposed wet cooling system).

One article of the USEPA's new ruling requires facilities to intake no more than 5 percent of the mean annual flow of a freshwater stream or river. By comparison, proposed wet cooling for CPP is 0.3% of the annual American River flow according to USGS gauging station data, which is 94% lower than required by the ruling. [p. 65272 and p. 65316]

### 3.3 Dry Cooling Systems – USEPA Analysis and Findings

Section C [p. 65282 – 65284] is entitled “*Why EPA Is Not Adopting Dry Cooling as the Best Technology Available for Minimizing Adverse Environmental Impact?*” In that section, the USEPA reports, “EPA rejects dry cooling as best technology available for a national requirement and under the subcategorization strategies described above, because the technology of dry cooling carries costs that are sufficient to pose a barrier to entry to the marketplace for some projected new facilities. Dry cooling technology also has some detrimental effect on electricity production by reducing energy efficiency of steam turbines...Finally, dry cooling technology may pose unfair competitive disadvantages by region and climate.”

The USEPA recognizes that dry cooling may be advantageous in moderate to cool climates areas that are seeking to minimize water use to avoid adverse impact to endangered species, or arid environments where water is simply not available, and writes, “Although EPA has rejected dry cooling technology as a national minimum requirement, EPA does not intend to restrict the use of dry cooling or to dispute that dry cooling may be the appropriate cooling technology for some facilities. This could be the case in areas with limited water available for cooling or waterbodies with extremely sensitive biological resources (e.g., endangered species, specially protected areas).”

The benefit of dry cooling in eliminating visual plumes, fog, mineral drift, and water treatment and disposal issues associated with wet cooling towers is also recognized by the USEPA.

The USEPA reports on the cost of dry cooling systems, and how the costs associated with building new plants with dry cooling systems may have the unintended outcome of actually increasing environmental impacts:

“Furthermore, EPA is concerned that requiring dry cooling for a subcategory of new facilities would create a disincentive to building a new combined-cycle facility (with associated lower flows) in lieu of modifying existing facilities, which may have greater environmental impacts. Dry cooling systems can cost as much as three times more to install than a comparable wet cooling system.”

“Because dry cooling systems are so much larger than wet cooling systems, these systems’ operation and maintenance require more parts, labor, etc. Costs of this magnitude, when imposed upon one subcategory of facilities but not another, provide a disparate competitive environment, especially for deregulated energy markets.”

USEPA’s supporting document *316(b) Technical Development Document*, Chapter 4, provides a comparison of capital costs between equally sized combined-cycle plants for wet and dry cooling tower systems. It reveals that the dry cooling plant’s capital costs would exceed those of the wet cooling tower plant by a factor of 3.3. For a typical, modern 700-MW plant, the installed wet cooling tower capital cost is approximately \$10 million, while the dry cooling installation would cost approximately \$33 million. The operation and maintenance costs of the wet cooling tower (without including the effects of energy penalties) would be \$1.8 million per year, while the dry cooling system would cost \$7.4 million per year. Without incorporating energy penalties, the ratio of operation and maintenance costs of dry cooling to wet cooling for a typical 700-MW combined-cycle power plant would be greater than 4 to 1. After factoring in the recurring costs of energy penalties for the two systems, the recurring annual costs increase to \$2.3 million for the wet tower plant and \$10.4 million for the dry cooling plant. This corresponds to a dry to wet ratio also greater than 4 to 1. The total annualized cost ratio for this model facility is 4.2 to 1. [316(b) TDD, p. 4-8].

The USEPA recognizes that a national ruling imposing dry cooling would prevent new plants from being built due to the associated costs. Therefore, aging, inefficient, and dirtier plants would be run longer than originally designed, or modified in order to avoid the substantial penalties involved with constructing new, efficient and cleaner-technology power plants.

### **3.4 Non-aquatic Environmental Effects of Dry Cooling (Fuel Waste and Increased Air Emissions)**

The USEPA continues its analysis and discussion on the energy penalty associated with dry cooling and its affect on the non-aquatic environment.

The USEPA writes, “Given the performance penalty of dry cooling versus wet cooling, the incremental air emissions of dry cooling as compared with wet cooling, provide additional support for why EPA is rejecting dry cooling. Dry cooling technology results in a performance penalty for electricity generation that is likely to be significant under certain climatic conditions. By “performance penalty”, USEPA means that dry cooling technology requires the power producer to use more energy than would be required with recirculating wet cooling to produce the same amount of power. USEPA concludes that performance penalties associated with dry cooling tower systems pose a significant feasibility problem in some climates.” Furthermore, USEPA writes, “These performance penalties could have significant technical feasibility implications. For example, dry cooling facilities have as a design feature turbine backpressure limits that often trigger a plant shut down if the back pressure reaches a certain level. Peak summer effects of inefficiency of dry cooling can and do cause turbine backpressure limits to be exceeded at some demonstrated plants, which in turn, experience shutdown conditions when the back pressure limits are reached. In addition, these performance penalties could pose potential power supply and reliability issues if dry cooling were required on a nationwide or regional basis. For example, USEPA estimates that in hot climates dry cooling equipped power plants experience peak summer energy penalties of 3.4 to 4.3 percent for combined-cycle plants. These peak summer penalties represent significant reductions in production at power plants in periods when demand is greatest.”

The USEPA continues on to discuss the effects of dry cooling on air emissions. It writes, “***Because of the performance penalty, power producers using dry cooling produce more air emissions per kilowatt-hour of energy produced.*** Nationally, EPA estimates that a minimum requirement based on dry cooling would cause significant air emissions increases over wet cooling systems. EPA projects for the dry cooling alternative that CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, and Hg emissions would increase by 8.9 million [tons], 22,300 [tons], 47,000 [tons], and 300 pounds per year, respectively.” [p. 65283, emphasis added]. According to a table footnote, “*for the mercury emissions alone, these emissions are equivalent to the addition of three 800-MW coal-fired power plants operating at near full capacity*” [316(b) TDD Table 3-8] [emphasis added]. In Chapter 3 of the USEPA’s 316(b) *Technical Development Document*, there is a marked coincidence between maximum air emissions that would be contributed due to dry cooling and the periods of the most severe regional air pollution problems. “In the cases where performance penalties are high (i.e., in hot climates or during hot climatic periods), the increases in air emissions due to the potential adoption of dry cooling-based requirements are of concern to the Agency.” [p. 65305]

USEPA’s 316(b) *Technical Development Document* discusses the land use impacts associated with dry cooling. USEPA reports dry cooling towers generally require approximately 3 to 4 times the area of a wet tower for a comparable cooling capacity. It concludes that this would have some affect on wetlands and other land habitat that would be subject to adequate protection under Section 404 permit programs [316(b) TDD, p. 3-34].

USEPA's 316(b) *Technical Development Document*, Chapter 4, which is a focused study on dry cooling, estimates that a national dry cooling based regulatory alternative would result in 1900 MW of lost energy. "Air emissions increases as a result of this replacement capacity, if they were to come from increased generation across the US market, would be equivalent to those of three new 800 MW coal-fired power plants. Alternatively, if the replacement capacity comes from new capacity exclusively, it would be from dry cooling equipped plants with the associated elevated capital and annual costs and land area requirements. Therefore, EPA considers the issue of inefficiency of dry cooling, and EPA's subsequent rejection of the dry cooling alternative, to be principal to the concept of energy conservation. ***Considering that the State of California recently experienced shortages of demand less than the energy penalty of the dry cooling option, the imposition of 1900 MW of mean annual energy penalty capacity loss on planned new power plants does not support the Administration's Energy Plan and associated Executive Orders.***" [emphasis added] [316(b) TDD, P. 4-7].

In one of the comment sections discussing non-aquatic environmental effects, some commenters claim that air emissions from electricity generation would increase because of energy penalties from dry cooling systems. The USEPA writes, "These commenters state that an energy penalty creates a need for replacement power, which must be met by even more new generating capacity resulting in an increased potential for environmental impacts (such as increased air emissions). The comments add further that estimating those emissions would project the costs of power production and the mix of generating capacities (e.g., coal-fired, nuclear) available at the time of anticipated demand." [p. 65305]

The USEPA is responsible for balancing all forms of environmental planning and ensuring activities and projects comply with national objectives. Their role is to determine the best technologies available that meet a multitude of environmental goals involving natural resources (fuel consumption), water, and air quality, and to strike a balance among all options to achieve those goals. With those responsibilities in mind, the USEPA summarizes its study of cooling options to achieve that balance and writes:

"EPA estimates that, for a newly constructed and designed facility, the peak summer shortfall could exceed the annual penalty by an additional 3 percent. This value could increase significantly as the facility ages; it hinges on regular and thorough maintenance. EPA concludes that the air emissions increases from power plants due to adoption of a requirement based on dry cooling would be counter to the performance of a best technology available candidate technology. Changes in energy consumption associated with dry cooling would result in changed fuel consumption and therefore could result in greater air emissions from power plants using dry cooling than would occur if the plants used wet cooling." [p.65306]

The USEPA concludes, “These additional non-aquatic environmental impacts (in the form of air emissions) further support EPA’s determination that dry cooling does not represent best technology available for minimizing adverse environmental impact on a national or region-specific basis.” [p. 65283 – 65284]

### **3.5 Comments from Industry, and USEPA Responses**

In the commentary section of the ruling that includes comments from industry users and the USEPA’s editorial responses to some of the comments, the USEPA reports, “The cost of dry cooling systems is discussed in a variety of comments. Generally, all commenters discuss elevated capital and operating and maintenance (O&M) costs in comparison with similar capacity recirculating wet cooling towers. An analysis of modeled new combined-cycle plants in five regions of the United States was submitted with one comment. This analysis estimated that capital and total O&M costs for dry cooling systems exceed those for wet cooling systems by greater than 75 percent, regionally and nationally.... Even commenters in favor of dry cooling as the best technology available acknowledge that the cost of a dry cooling system can be as much as three times that of a comparable wet cooling system.” The USEPA reports that some commenters in favor of dry cooling contest that the cost of the technology is clearly not wholly disproportionate to the environmental benefit gained, and further state that “a 1 to 2 percent loss for the sake of greater protection of water resources is comparable to other efficiency penalties EPA requires of the electric industry for reductions in NO<sub>x</sub> and SO<sub>2</sub> emissions.” The USEPA editorially responds to these claims by writing, “The performance penalties of dry cooling systems play a significant role in EPA’s decision to reject dry cooling as the best technology available.” [pp. 65304-65305]

### **3.6 Hybrid Technology**

Hybrid wet and dry cooling systems are addressed in several comments. One commenter contends that the viability of hybrid systems for large-scale cooling operations (e.g., at a power plant with capacity greater than 500 MW) is uncertain. Addressing hybrid, or wet/dry cooling systems, the USEPA writes in its ruling, “EPA considers hybrid cooling systems not to be adequately demonstrated for power plants of the size projected to be within the scope of the rule. As such, EPA has not adopted the technology as a component of the best technology available requirements of today’s rule.” [p. 65305]

## 4.0 LEGAL AND OPERATIONAL CONSTRAINTS ON WATER SUPPLY

### 4.1 Basis of SMUD's Existing Water Supply

SMUD holds a contract with the United States Bureau of Reclamation ("Reclamation") for the delivery of up to 75,000 acre-feet (AF) of water per year. Of that 75,000 AF, 60,000 AF is Central Valley Project (CVP) supply delivered through the Folsom-South Canal. The remaining 15,000 AF is based on a senior water right (not a CVP water right) and is simply conveyed by Reclamation through the Folsom-South Canal to SMUD. SMUD's current contract expires in 2012. However, federal law **mandates** that Reclamation must renew that contract at SMUD's request. (See Act of June 21, 1963, § 1, Pub.L.No. 88-44, 77 Stat. 68.) SMUD has made that request and has been engaged in negotiations for more than two years. In addition, this right of continual renewal has been recognized by Reclamation in the draft renewal contract proposed by Reclamation and currently under negotiation between SMUD and Reclamation. (*Copy available from SMUD or Reclamation*). A will-serve letter from Reclamation is provided in Appendix A, and a copy of the existing contract is provided in Appendix E. Thus, with or without the approval of the CPP, SMUD holds the right to the delivery and use of 75,000 AF per year of water from the American River and may exercise that right independent of this approval.

### 4.2 CVP Water Operations, Allocation, and Reliability

Reclamation manages its reservoir operations in both the American and Sacramento River watersheds to meet multiple agreements for consumptive and non-consumptive water uses. Minimum instream flows and water for environmental purposes (i.e., instream flow enhancement ((b)(2)), refuges and Sacramento-San Joaquin Delta (Delta) standards) are Reclamation's responsibilities and are met irrespective of SMUD's water diversions.

On the American River, similar to all of the CVP, there is a use priority for the available CVP water supply. The priority system places the highest value on instream environmental purposes, including Endangered Species Act requirements, environmental obligations outside of the American River basin and CVP municipal and industrial (M&I) contractors, followed finally by the CVP agricultural contractors, which are lowest in priority.

On average, the 8,000 AF per year (9,000 AF per year in a peak year) SMUD CPP diversion represents, on average, less than one percent of the water released annually from Folsom Dam. During the driest 10 percent of years, the 8,000 AF still constitutes only one percent of the water released from Folsom Dam. This amount, about 12.5 cubic feet per second (CFS) is generally too small to even observe in the lower American River. Figures F-1 and F-2 in Appendix F illustrate the relationship of the CPP diversion to other American River and CVP water uses.

It is also worth noting that at least half of the diversions made by SMUD are considered non-consumptive, and are discharged back into water systems, which eventually flow to the Delta. Thus, to the extent that any of these flows might have been used for environmental purposes in the Delta or for water supply south of the Delta, SMUD's use and method of discharge continues to make them available.

Reclamation currently allocates water supply between irrigation and M&I uses based upon a 1995 Administrative Proposal for M&I Reliability ("Proposal"). This Proposal assures that, except in circumstances of catastrophic drought, the M&I function of the project will not be shorted more than 25% of the historically used amount (as adjusted for growth). As a result of the different levels of priority created by this Proposal, and the fact that Reclamation has independent obligations to ensure minimum flows for fish and wildlife, the effect of an M&I contractor taking more or less water under its contract is felt primarily by the CVP irrigation community. As a practical matter, the effect of SMUD taking an additional 8,000 AF under its contract can barely be measured by the irrigation community, as this 8,000 AF represents less than four tenths of one percent (0.34%) of the nearly 2,360,000 AF supply contracted to CVP irrigators<sup>1</sup>. If the water use of the Settlement Contractors (who are subject to a different shortage scheme) is included, this 8,000 AF represents less than two tenths of one percent (0.18%).

Reclamation has issued for public notice a draft M&I Shortage Policy that would replace the 1995 Administrative Proposal. The draft policy continues to allocate water in essentially the same way as the 1995 Proposal. However, the draft policy actually provides *additional* assurances to SMUD in its operation of the CPP. The draft policy, if adopted, will recognize that in a water-short year, SMUD's supply should not be reduced below that needed to assure public health and safety. Because in a water-short year, CVP power production already dips to dangerously low levels, the public health and safety provision would assure that SMUD will continue to receive the water necessary to operate the CPP to produce power needed to supply SMUD customers.

#### **4.3 Water Forum Agreement, USBR Needs Analysis, and American River Cumulative Impact Report**

SMUD takes its responsibilities to the American River very seriously. During the six years of developing, analyzing, and negotiating a regional solution to the present and future needs of the American River basin, SMUD was an active participant in the Water Forum process and the utility's water requirements were recognized as part of the increasing demand that must be met by the plan. The *Water Forum Agreement* addresses two co-equal objectives: provide a reliable and safe water supply for the region's economic health and planned development to the year 2030 and preserve the fishery, wildlife, recreational and aesthetic values of the Lower American River. The *Water Forum Agreement* was the result of a 6-year collaborative problem-solving negotiation, which included agricultural and business leaders, citizen and environmental

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<sup>1</sup> For this calculation, only the approximately 395,000 AF of CVP Sacramento River project agricultural contractors and 1,965,000 AF of CVP Delta export agricultural contractors were included. Not included are the nearly 2,560,000 AF of water rights settlement contract water.

organizations, water managers, and local governments in Sacramento, Placer and El Dorado counties. In April 2000, the *Water Forum Agreement* was signed by 40 stakeholder organizations/agencies. A list of the Water Forum Stakeholders is provided in Appendix F.

As a signatory to the *Water Forum Agreement*, SMUD is committed to the co-equal principals of improving the environmental health of the river while protecting the reliability and quality of water supplies to meet existing and increasing demands on the American River water users now and into the future. The comprehensive *Water Forum Agreement* allows the region to meet its needs in a balanced way through implementation of seven elements. Included among the seven major elements designed to facilitate the Water Forum objectives is support by all parties of an improved pattern of fishery flows from Folsom Reservoir and dealing with key issues such as groundwater management, water diversions, dry-year water supplies, water conservation, and protection of the Lower American River.

*A fundamental assumption underlying all of this analysis and consideration is the assumption that SMUD's CVP water supply would be used for electricity generation at the Rancho Seco site for the Sacramento area.*

SMUD continues to demonstrate its responsibility under and commitment to the *Agreement* through regular participation in Water Forum Successor Effort activities, as a representative in the Water Forum Coordinating Committee (which manages the major activities of the Water Forum), and through its vigorous involvement in the American River Operations Group (AROG). The AROG, an assemblage of scientists, engineers, and planners representing Reclamation, NMFS, USFWS, DFG, WAPA, and representatives from a variety of other interests, meets as often as bi-weekly to assess real-time lower American River operations to provide coordination input and recommendations to the CVP operating agencies, facilitating river management coordination for all beneficial uses, and ensuring the needs of the Lower American River fishery resources are maintained and even enhanced when possible.

A "Water Needs Assessment" conducted by Reclamation as a part of SMUD's CVP contract renewal process has confirmed that SMUD has the need for the water entitlements held under its contract. Thus, the availability of the CVP water sufficient to support the CPP for its useful life is assured. Reclamation has also shown its intention to renew the SMUD contract in its recent (August 2001) *Draft American River Basin Cumulative Impact Report*. This document is predicated on CVP operations modeling of conditions expected to occur in 2030, **including** the 8,000 AF delivery of water to the CPP.

SMUD has been supportive of the American River Corridor Management Plan that will promote a cooperative approach to managing and enhancing the Lower American River within the framework of the 1985 American River Parkway Plan. The River Corridor Management plan includes as part of the plan the protection and enhancement of fisheries resources and in-stream habitat. The management plan will strengthen

management provisions and reinforce the cooperative relationships that have developed over the past seven years through the Water Forum and the Lower American River Task Force.

In keeping with its plan to promote cogeneration opportunities, SMUD began constructing cogeneration facilities at sites throughout the Sacramento area. Some of these units are already in place and are being served with water from the City of Sacramento. To accommodate future facilities, SMUD, the City of Sacramento, and the County of Sacramento have proposed a three-party agreement whereby SMUD receives a water supply from the City for these future facilities in exchange for SMUD transferring 15,000 AF of its CVP entitlement to the County for the County to use for planned development as approved in the County of Sacramento General Plan (1995). SMUD and the County of Sacramento have also begun negotiations for the assignment of an additional 15,000 AF of CVP water from SMUD to the County. All the parties will benefit from these two assignments, and in fact, the assignment by SMUD of 30,000 AF of its CVP water was discussed and agreed to by all stakeholders as part of the negotiation over SMUD's Purveyor Specific Agreement that implements the Water Forum Agreement. Another beneficiary of the SMUD assignment is the habitat of the lower American River. Because the diversion points for the assigned water will be located downstream of the FSC intake (most likely at the new Freeport joint diversion facility), this assigned water will remain in the lower American River to the benefit of the instream environment.

#### **4.4 SWRCB Resolution 75-58 and Water Code Section 13550**

State Water Resources Control Board Resolution 75-58 has been identified by CEC staff as a basis for its questioning the use of SMUD's existing water supply for the CPP. Resolution 75-58, by its terms, strongly discourages the use of new fresh water supplies for industrial processes, instead encouraging the use of recycled water. The portion of Resolution 75-58 that speaks to water supplies applies to applications before the State Board only when an applicant has applied for a **new** water right, or to change the place of use, point of diversion, or purpose of use of an existing water right. Here, SMUD does not need to apply to the State Board for a new water right (or for a change in place or use, purpose of use, or point of diversion) because SMUD holds the existing entitlements to water needed for this project. Therefore, as a new right is not being requested, and as no permissions from the State Board are needed to use the existing entitlements, the policy of Resolution 75-58, which discourages the issuance of **new** rights for the use of fresh water, does not apply in this case.

It is also important to note that the policies behind Resolution 75-58 do not apply in this case, but if they were applicable, they are, in fact, satisfied. Those two policies are: (i) to ensure adequate fresh water supplies for irrigation, and (ii) to ensure adequate Delta flows. In the case of the CPP, the cooling water discharged from the Plant is available for downstream beneficial uses. And after these users have used the water it flows further downstream where it is discharged into the Delta. Thus, the policy reasons

behind Resolution 75-58's discouragement of the use of fresh water for industrial processes are met though they are inapplicable in this case.

California Water Code Section 13550 has also been mentioned as a basis for questioning the use of SMUD's existing water supply for the CPP. This section considers use of potable domestic water for industrial purposes a waste, and an unreasonable use if recycled water is available of adequate quality and at reasonable cost. This provision is simply inapplicable to the CPP as the water taken from the FSC and used for cooling purposes (and the boiler cycle) is not potable water. Rather, it is raw water (albeit of high quality) that would still need to be treated for potable uses.

#### **SOURCES:**

City-County Office of Metropolitan Water Planning. 1999 (Oct). *Final Environmental Impact Report for the Water Forum Proposal*.

City-County Office of Metropolitan Water Planning. 2000 (Jan). *Water Forum Agreement*.

City-County Office of Metropolitan Water Planning. 2000 (Apr). *Memorandum of Understanding for the Water Forum Agreement*.

U.S. Bureau of Reclamation. 2001 (Aug). *American River Basin Cumulative Impact Report*

## 5.0 CONCLUSIONS

CPP is currently designed to be highly efficient and minimize environmental impacts while making best use of natural resources and keeping costs low. Recirculating wet cooling using FSC water is fundamental to efficient power plant operation that will benefit the region and SMUD's customer-owners. With the proposed design, CPP provides balance to the environment, taking into account fuel efficiency, water resources, air quality, biological resources, land use, visual aesthetics, and noise.

Implementing alternative technologies such as dry cooling and hybrid cooling, or constructing alternative water source facilities for reclaimed or brackish water, would:

- Upset the balance of natural resources
- Increase fuel consumption while producing less power
- Decrease power plant efficiency
- Create a net increase in regional air emissions per megawatts produced
- Disrupt the environment during construction and operation of alternative water source facilities
- Increase power plant operating noise
- Negatively impact visual aesthetics
- Increase the amount of land needed for plant construction
- Eliminate potential downstream beneficial water uses in Clay Creek
- Increase installation and lifetime costs that would be passed through to SMUD customer-owners
- Delay plant design and construction schedule, which will increase costs

A recirculating wet cooling system is by far, the least expensive cooling system analyzed, yet it still preserves balance among all natural resources.

The USEPA considers recirculating wet cooling systems, as proposed for CPP, to be the best cooling option that takes into account all environmental factors. The USEPA does not consider dry cooling to offer the best technology for minimizing adverse environmental impact on either a national or region-specific basis.

The water proposed for CPP, conveyed by Folsom-South Canal, is available through a longstanding and renewable contract with USBR. The water allocation has been supported by 40 regional Stakeholder organizations and agencies through the Water Forum Agreement. Implementation of this agreement is based upon seven guiding elements, including protection of the Lower American River.

SMUD concludes recirculating wet cooling using FSC water is the best choice for the environment, the region, SMUD's customer-owners, and CPP.